



## **USC SALTVILLE BRINE, LLC**

4800 SAN FELIPE  
HOUSTON, TEXAS 77056  
MAIN OFFICE: (713) 877-2600

June 30, 2014

Delivered Via Email

[Bennett.James@EPAMail.EPA.gov](mailto:Bennett.James@EPAMail.EPA.gov)

Mr. James C. Bennett, Environmental Engineer  
United States Environmental Protection Agency  
Ground Water and Enforcement Branch  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

**RE: Notice of Intent to Drill  
UIC Permit Number VAS3G931BSMY**

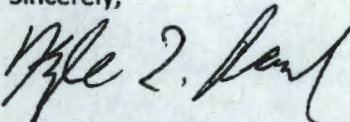
Dear Mr. Bennett:

USCSB intends to drill two (2) new Injection Wells (identified as USCSB Well#2 & Well#3) in the Saltville Brine Field under UIC Permit VAS3G931BSMY, with the most recent effective date of May 29, 2014. The drilling and construction of the wells are expected to begin in late July 2014, depending on rig availability, and to be completed in approximately 3 months. Attached is a scan of the amended Surety Performance Bond for a total of nine (9) Injection Wells and four hundred, fifty thousand dollars (\$450,000). The original Bond Rider No. 3 will be mailed via US Mail to your attention. Attached also is the Proposed Wells Exhibit in plan view and the Proposed Wellbore Detail showing the expected formation depths and proposed casing depths for both of the proposed wells.



Mr. James Bennett - EPA  
June 30, 2014

Sincerely,



Kyle Rash, President  
USC Saltville Brine, LLC  
4800 San Felipe  
Houston, Texas 77056-3908  
Office: (713) 877-2601  
[KRash@UnitedSalt.com](mailto:KRash@UnitedSalt.com)

Attachments:

Surety Performance Bond (10 Pages)  
Proposed Wells Exhibit (1 Sheet)  
Proposed Wellbore Detail (1 Sheet)

Cc Via Email:

Stephen Platt, [Platt.Steve@EPA.gov](mailto:Platt.Steve@EPA.gov)  
Jim O'Donnell, [JODonnell@UnitedSalt.com](mailto:JODonnell@UnitedSalt.com)  
Scott Whitelaw, [SWhitelaw@TUM.com](mailto:SWhitelaw@TUM.com)  
Mark Cartwright, [MCartwright@UnitedBrine.com](mailto:MCartwright@UnitedBrine.com)  
Kathy Gillies, [CGillies@TUM.com](mailto:CGillies@TUM.com)  
Stacey Owens, [SOwens@TUM.com](mailto:SOwens@TUM.com)  
Dave Dickehut, [DDickehut@UnitedBrine.com](mailto:DDickehut@UnitedBrine.com)  
Ernest Sands, [ESands@UnitedSalt.com](mailto:ESands@UnitedSalt.com)  
Roscoe Call, [RCall@UnitedSalt.com](mailto:RCall@UnitedSalt.com)  
Kathy Dubiel, [KDubiel@UnitedSalt.com](mailto:KDubiel@UnitedSalt.com)  
Eileen Rangel, [ERangel@TUM.com](mailto:ERangel@TUM.com)  
Joseph Vance, [JVance@RaeganEngineering.com](mailto:JVance@RaeganEngineering.com)



**BOND RIDER NO. 3**

Attaching to and forming part of Surety Performance Bond No. RLB0010725, effective August 28, 2007, on behalf of USC Saltville Brine, LLC as Principal, in favor of U.S. Environmental Protection Agency as Oblige, issued by RLI Insurance Company as Surety, in the amount of Three Hundred Fifty Thousand and No/100 Dollars (\$350,000.00).

It is understood and agreed that effective June 4, 2014 the above has been increased by One Hundred Thousand and No/100 Dollars (\$100,000.00).

Total penal sum is now amended to read, Four Hundred Fifty Thousand and No/100 Dollars (\$450,000.00).

The current description of the wells under the permit that will be covered by this bond are as follows:

**UIC Permit No. VAS3G931BSMY.....9 wells @\$50K per well**

Well 1A, Well 9, Well 13A, Well 14A, Well 15, Well 17, Well 131, Well #2 and Well #3

All other conditions and terms to remain as originally written or previously amended by rider.

Signed, sealed and dated this 4<sup>th</sup> day of June, 2014.

USC Saltville Brine, LLC

Principal

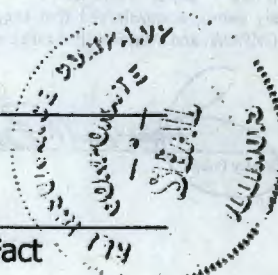
By: Kyle R. Rash

Kyle Rash President  
(Printed Name & Title)

RLI Insurance Company  
8 Greenway Plaza, Suite 400  
Houston, TX 77046  
Surety

By: Jason T. Kilpatrick

Jason T. Kilpatrick, Attorney-in-Fact







RLI Surety  
A division of RLI Insurance Company

RLB0010725

## POWER OF ATTORNEY RLI Insurance Company

### Know All Men by These Presents:

That the RLI INSURANCE COMPANY, a corporation organized and existing under the laws of the State of Illinois, and authorized and licensed to do business in all states and the District of Columbia does hereby make, constitute and appoint: JASON T. KILPATRICK in the City of HOUSTON, State of TEXAS, as Attorney-in-Fact, with full power and authority hereby conferred upon him to sign, execute, acknowledge and deliver for and on its behalf as Surety and as its act and deed, all of the following classes of documents to-wit:

**\$450,000.00**

Indemnity, Surety and Undertakings that may be desired by contract, or may be given in any action or proceeding in any court of law or equity; policies indemnifying employers against loss or damage caused by the misconduct of their employees; official, bail and surety and fidelity bonds. Indemnity in all cases where indemnity may be lawfully given; and with full power and authority to execute consents and waivers to modify or change or extend any bond or document executed for this Company, and to compromise and settle any and all claims or demands made or existing against said Company.

The RLI INSURANCE COMPANY further certifies that the following is a true and exact copy of a Resolution adopted by the Board of Directors of RLI Insurance Company, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers-of-Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

IN WITNESS WHEREOF, the RLI Insurance Company has caused these presents to be executed by its PRESIDENT with its corporate seal affixed this

ATTEST:

Jean M. Stephenson  
CORPORATE SECRETARY

State of Illinois )  
County of Peoria ) SS

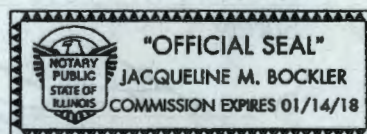


RLI INSURANCE COMPANY

Michael J. Stone  
PRESIDENT

On this 4 day of June 2014 before me, a Notary Public, personally appeared Michael J. Stone and Jean M. Stephenson, who being by me duly sworn, acknowledged that they signed the above Power of Attorney as President and Corporate Secretary, respectively, of the said RLI INSURANCE COMPANY, and acknowledged said instrument to be the voluntary act and deed of said corporation.

Jacqueline M. Bockler  
Notary Public



SPA028 (03/11)



**BOND RIDER NO. 2**

Attaching to and forming part of Surety Performance Bond No. RLB0010725, effective August 28, 2007, on behalf of Texas Brine Company Saltville, LLC as Principal, in favor of U.S. Environmental Protection Agency as Oblige, issue by RLI Insurance Company as Surety, in the amount of Three Hundred Fifty Thousand and No/100 Dollars (\$350,000.00).

It is understood and agreed that effective July 8, 2013, the name of the principal is amended to read:

**USC Saltville Brine, LLC**

All other conditions and terms to remain as originally written or previously amended by rider.

Signed, sealed and dated this 14<sup>th</sup> day of November, 2013.

USC Saltville Brine, LLC  
Principal

By: CB Gillies

CB Gillies Secretary  
(Printed Name & Title)

RLI Insurance Company  
8 Greenway Plaza, Suite 400  
Houston, TX 77046  
Surety

By: Robbie Duxbury  
Robbie Duxbury, Attorney-in-Fact

SEAL



# RLI

RLI Surety  
A division of RLI Insurance Company

RLB0010725

## POWER OF ATTORNEY RLI Insurance Company

### Know All Men by These Presents:

That the RLI INSURANCE COMPANY, a corporation organized and existing under the laws of the State of Illinois, and authorized and licensed to do business in all states and the District of Columbia does hereby make, constitute and appoint: ROBBIE DUXBURY in the City of HOUSTON, State of TEXAS, as Attorney-in-Fact, with full power and authority hereby conferred upon him to sign, execute, acknowledge and deliver for and on its behalf as Surety and as its act and deed, all of the following classes of documents to-wit:

\$350,000.00

Indemnity, Surety and Undertakings that may be desired by contract, or may be given in any action or proceeding in any court of law or equity; policies indemnifying employers against loss or damage caused by the misconduct of their employees; official, bail and surety and fidelity bonds. Indemnity in all cases where indemnity may be lawfully given; and with full power and authority to execute consents and waivers to modify or change or extend any bond or document executed for this Company, and to compromise and settle any and all claims or demands made or existing against said Company.

The RLI INSURANCE COMPANY further certifies that the following is a true and exact copy of a Resolution adopted by the Board of Directors of RLI Insurance Company, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers-of-Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

IN WITNESS WHEREOF, the RLI Insurance Company has caused these presents to be executed by its PRESIDENT with its corporate seal affixed this

ATTEST:

Jean M. Stephenson  
CORPORATE SECRETARY

State of Illinois )  
County of Peoria ) SS

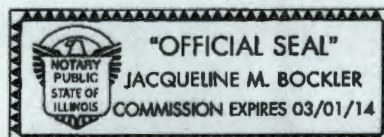


RLI INSURANCE COMPANY

Michael J. Stone  
PRESIDENT

On this 14 day of November 2013 before me, a Notary Public, personally appeared Michael J. Stone and Jean M. Stephenson, who being by me duly sworn, acknowledged that they signed the above Power of Attorney as President and Corporate Secretary, respectively, of the said RLI INSURANCE COMPANY, and acknowledged said instrument to be the voluntary act and deed of said corporation.

Jacqueline M. Bockler  
Notary Public



SPA027 (03/11)



**BOND RIDER NO. 1**

Attaching to and forming part of Surety Performance Bond, Bond No. RLB0010725 effective August 28, 2007 on behalf of Texas Brine Company Saltville, LLC as Principal, in favor of U.S. Environmental Protection Agency as Oblige, in the amount of Ninety Thousand and No/100 Dollars (\$90,000.00).

It is understood and agreed that effective October 27, 2010 the above has been increased by Two Hundred Sixty Thousand and No/100 Dollars (\$260,000.00).

Total penal sum is now amended to read, Three Hundred Fifty Thousand and No/100 Dollars (\$350,000.00).

The current description of the wells under the permit that will be covered by this bond are as follows:

**UIC Permit No. VAS3G931BSMY..... 7 wells @\$50K per well**

**Well 1A, Well 9, Well 13A, Well 14A, Well 15, Well 17, Well 131**

All other conditions and terms to remain as originally written.

Signed, sealed and dated this 27<sup>th</sup> day of October 2010

Texas Brine Company Saltville, LLC  
Principal

By: 

RLI Insurance Company  
Surety

By: 

Greg E. Chilson, Attorney-in-Fact





**RLI Surety**  
A division of RLI Insurance Company

RLB0010725

# POWER OF ATTORNEY

RLI Insurance Company

## Know All Men by These Presents:

That the RLI INSURANCE COMPANY, a corporation organized and existing under the laws of the State of Illinois, and authorized and licensed to do business in all states and the District of Columbia does hereby make, constitute and appoint: GREG E. CHILSON in the City of HOUSTON, State of TEXAS, as Attorney-in-Fact, with full power and authority hereby conferred upon him to sign, execute, acknowledge and deliver for and on its behalf as Surety and as its act and deed, all of the following classes of documents to-wit:

**\$350,000.00**

Indemnity, Surety and Undertakings that may be desired by contract, or may be given in any action or proceeding in any court of law or equity; policies indemnifying employers against loss or damage caused by the misconduct of their employees; official, bail and surety and fidelity bonds. Indemnity in all cases where indemnity may be lawfully given; and with full power and authority to execute consents and waivers to modify or change or extend any bond or document executed for this Company, and to compromise and settle any and all claims or demands made or existing against said Company.

The RLI INSURANCE COMPANY further certifies that the following is a true and exact copy of a Resolution adopted by the Board of Directors of RLI Insurance Company, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers-of-Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

(Blue shaded areas above indicate authenticity)

IN WITNESS WHEREOF, the RLI Insurance Company has caused these presents to be executed by its PRESIDENT with its corporate seal affixed this

ATTEST:

Jean M. Stephenson  
CORPORATE SECRETARY

State of Illinois )  
County of Peoria ) SS



Michael J. Stone  
PRESIDENT

On this 27 day of Oct. 2010 before me, a Notary Public, personally appeared Michael J. Stone and Jean M. Stephenson, who being by me duly sworn, acknowledged that they signed the above Power of Attorney as President and Corporate Secretary, respectively, of the said RLI INSURANCE COMPANY, and acknowledged said instrument to be the voluntary act and deed of said corporation.

Cherie L. Montgomery  
Notary Public



SPA026 (02/08)



**SURETY PERFORMANCE BOND****U.S. ENVIRONMENTAL PROTECTION AGENCY  
UNDERGROUND INJECTION CONTROL  
FINANCIAL RESPONSIBILITY REQUIREMENT****BOND COVERS THE PLUGGING OF INJECTION WELLS**Date Bond Executed: August 28, 2007Effective Date: August 28, 2007Principal: Texas Brine Company Saltville, LLC  
(Legal Name of Owner or Operator)4800 San Felipe, Houston, TX 77056  
(Business Address of Owner or Operator)Type of Organization: Limited Liability Company  
(Individual, joint venture, partnership, or corporation)State of Incorporation: TexasSurety(ies): RLI Insurance Company  
(Name)  
8 Greenway Plaza, Suite 400, Houston, TX 77046  
(Business Address)

EPA identification number, name, address, and plugging and abandonment amount(s) for each injection well guaranteed by this Bond. (Indicate plugging and abandonment amounts for each well. Attach separate list if necessary.

<u>Injection Well Information</u>	<u>Plugging And Abandonment Amount</u>
UIC Permit # VAS3G931BSMY 14-a, 13-b, & 4 wells to be developed	\$90,000.00

Total Penal Sum of Bond: \$90,000.00**KNOW ALL PERSONS BY THESE PRESENTS:**

THAT we, the Principal and the Surety(ies) hereto are firmly bound to the U.S. Environmental Protection Agency (hereinafter called "EPA"), in the above penal sum for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally; provided that, where the Surety(ies) are corporations acting as co-sureties, we, the Sureties, bind ourselves in such sum "jointly and severally" only for the purpose of allowing a joint action or actions against any or all of us and for all other



purposes each Surety binds itself jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety, but if no limit of liability is indicated, the limit of liability shall be the full amount of the penal sum.

**WHEREAS**, the Principal is required, under the Underground Injection Control Regulations, as amended, to have a permit or comply with provisions to operate under rule for each injection well identified above, and

the Principal is required to provide financial assurance for plugging and abandonment as a condition of the permit or approval to operate under rule, and

**WHEREAS**, said Principal shall establish a standby trust fund as is required when a surety bond is used to provide such financial assurance;

**NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH** that if the Principal shall faithfully perform plugging and abandonment, whenever required to do so, of each injection well for which this Bond guarantees plugging and abandonment, in accordance with the plugging and abandonment plan and other requirements of the permit or provisions for operating under rule and other requirements of the permit or provisions for operating under rule as may be amended, pursuant to all applicable laws, statutes rules and regulations, as such laws, statutes, rules, and regulations may be amended.

Or, if the Principal shall provide alternate financial assurance and obtain the EPA Regional Administrator's written approval of such assurance, within ninety (90) days after the date of notice of cancellation is received by both the Principal and the EPA Regional Administrator(s) from the Surety(ies), then this obligation shall be null and void. Otherwise it is to remain in full force and effect.

The Surety(ies) shall become liable on this Bond obligation only when the Principal has failed to fulfill the conditions described above.

Upon notification by the EPA Regional Administrator that the Principal has been found in violation of the plugging and abandonment requirements of the 40 CFR Part 144, for an injection well which this Bond guarantees performances of plugging and abandonment, the Surety(ies) shall either perform plugging and abandonment in accordance with the plugging and abandonment plan and other permit requirements or provisions for operating under rule and other requirements or place the amount for plugging and abandonment into a standby trust fund as directed by the EPA Regional Administrator.

Upon notification by an EPA Regional Administrator that the Principal has failed to provide alternate financial assurance and obtain written approval of such assurance from the EPA Regional Administrator(s) during the ninety (90) days following receipt by both the Principal and EPA Regional Administrator(s) of a notice of cancellation of the bond, the Surety(ies) shall place funds in the amount guaranteed for the injection well(s) into the standby trust fund as directed by the EPA Regional Administrator.



The Surety(ies) hereby waives notification of amendments to plugging and abandonment plans, permits, applicable laws, statutes, rules and regulations and agrees that no such amendment shall in any way alleviate its (their) obligation on this Bond.

The liabilities of the Surety(ies) shall not be discharged by any payment or succession of payments hereunder, unless and until such payment or payments shall amount in the aggregate to the penal sum of the Bond, but in no event shall the obligation of the Surety(ies) hereunder exceed the amount of said penal sum.

The Surety(ies) may cancel the Bond by sending notice by certified mail to the owner or operator and to the EPA Regional Administrator(s) for the Region(s) in which the injection well(s) is (are) located, provided, however, that cancellation shall not occur during the 120 days beginning on the date of receipt of the notice of cancellation by both the Principal and the EPA Regional Administrator(s), as evidenced by the return receipts.

The Principal may terminate this Bond by sending written notice to the Surety(ies); provided, however, that no such notice shall become effective until the Surety(ies) receive(s) written authorization for termination of the Bond by the EPA Region(s) in which the bonded injection well(s) is (are) located.

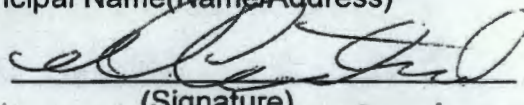
**IN WITNESS WHEREOF**, the Principal and the Surety(ies) have executed this Performance Bond and have affixed their seal on the date set forth above.

The persons whose signatures appear below hereby certify that they are authorized to execute this Surety Bond on behalf of the Principal and the Surety(ies) on the date this Bond was executed.

Texas Brine Company Saltville, LLC  
4800 San Felipe  
Houston, TX 77056

Principal Name(Name/Address)

By:



(Signature)

MARK CRETNEY, PRESIDENT

(Printed Name/Title)

Corporate Seal

Texas

State of Incorporation

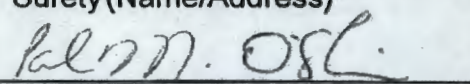
\$

Bond Premium

RLI Insurance Company  
8 Greenway Plaza, Suite 400  
Houston, TX 77046

Surety(Name/Address)

By:



(Signature)

Paul M. O'Sullivan, Attorney-in-Fact

Corporate Seal

Illinois

State of Incorporation

\$ 90,000.00

Liability Limit

(For every Co-Surety, provide signature(s), corporate seal, and other information in the same manner as for Surety above.)





RLI Surety | A Division of RLI Insurance Company

9025 North Lindbergh Dr. • Peoria, IL 61615  
(309) 692-1000 or (800) 645-2402

RLB0010725

## POWER OF ATTORNEY RLI Insurance Company

### Know All Men by These Presents:

That the RLI INSURANCE COMPANY, a corporation organized and existing under the laws of the State of Illinois, and authorized and licensed to do business in all states and the District of Columbia does hereby make, constitute and appoint: PAUL M. O'SULLIVAN

in the City of HOUSTON, State of TEXAS, as Attorney-in-Fact, with full power and authority hereby conferred upon him to sign, execute, acknowledge and deliver for and on its behalf as Surety and as its act and deed, all of the following classes of documents to-wit:

**\$90,000.00**

Indemnity, Surety and Undertakings that may be desired by contract, or may be given in any action or proceeding in any court of law or equity; policies indemnifying employers against loss or damage caused by the misconduct of their employees; official, bail and surety and fidelity bonds. Indemnity in all cases where indemnity may be lawfully given; and with full power and authority to execute consents and waivers to modify or change or extend any bond or document executed for this Company, and to compromise and settle any and all claims or demands made or existing against said Company.

The RLI INSURANCE COMPANY further certifies that the following is a true and exact copy of a Resolution adopted by the Board of Directors of RLI Insurance Company, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

(Blue shaded areas above indicate authenticity)

IN WITNESS WHEREOF, the RLI Insurance Company has caused these presents to be executed by its PRESIDENT with its corporate seal affixed this

ATTEST:

Jean M. Stephenson  
Corporate Secretary



RLI INSURANCE COMPANY

Michael J. Stone  
President

State of Illinois

County of Peoria

SS

On this 28 day of Aug. 2007 before me, a Notary Public, personally appeared Michael J. Stone and Jean M. Stephenson, who being by me duly sworn, acknowledged that they signed the above Power of Attorney as President and Corporate Secretary, respectively, of the said RLI INSURANCE COMPANY, and acknowledged said instrument to be the voluntary act and deed of said corporation.

Cherie L. Montgomery  
Notary Public



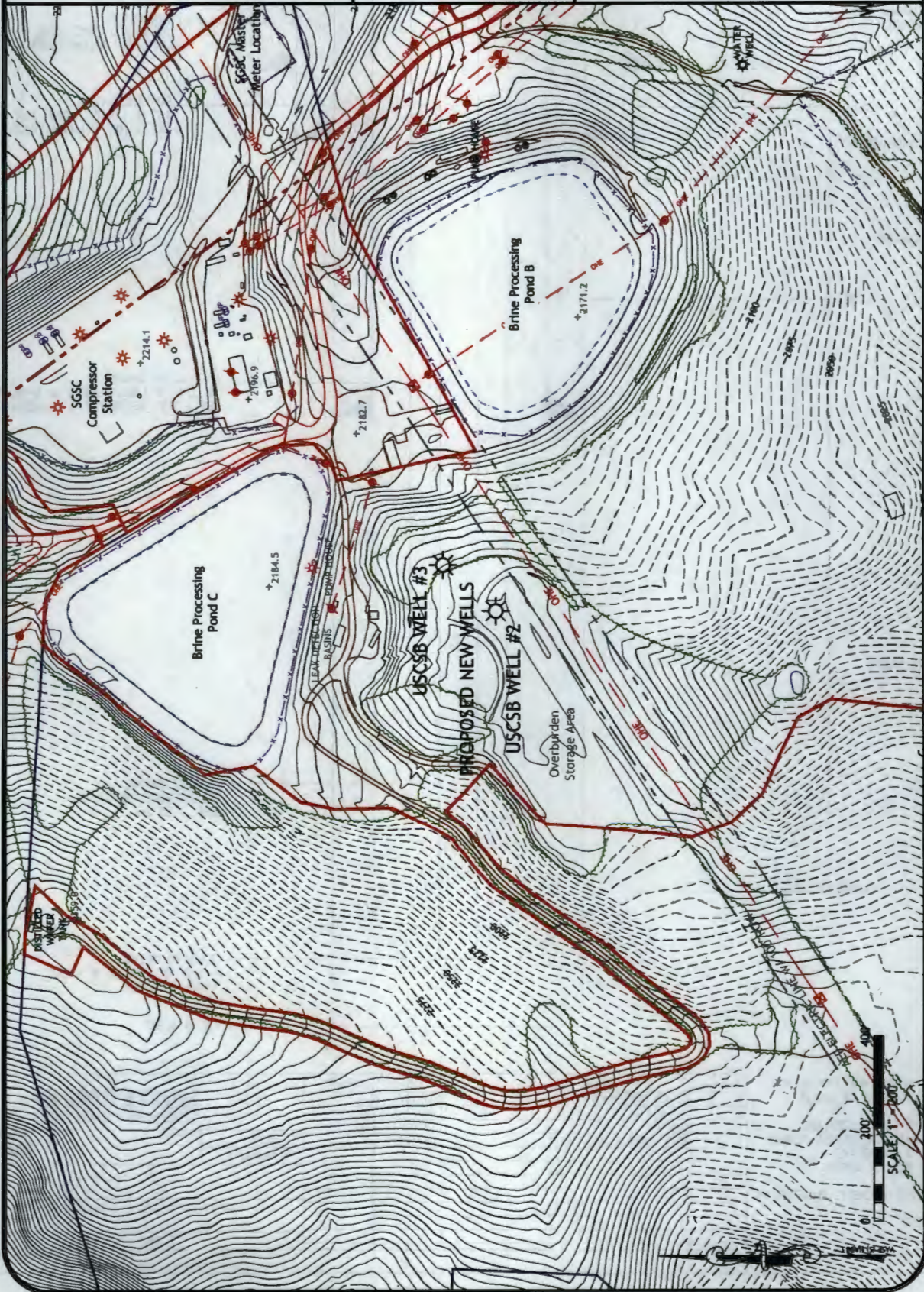




DESIGNED:	JV
DRAWN:	JV
CHECKED:	USCSB
DATE:	06/10/2014
SCALE:	AS SHOWN
SHEET #:	1 OF 1
FILE NAME:	USCSB Amendment X.dwg



SITE PLAN - PROPOSED USCSB WELLS #2 & #3  
USC SALTVILLE BRINE, LLC  
SALTVILLE, VIRGINIA





GROUND SURFACE

COPPER \*  
RIDGE

~230'

NOLICHUCKY\*

~780'

HONAKER\*

~1,200'

MacCRADY

~4000'

CONDUCTOR  
20" @ 200-300', 133#, J-55 8rd.  
SET ≥ 50' BELOW SURFACE

SURFACE CASING  
16" @ 1,000', 109#, J or K-55 8rd.  
SET ≥ 100' BELOW SURFACE

PRODUCTION CASING,  
10 3/4" @ 1,800', 51#, J or K-55 Butt.  
SET ≥ 200' BELOW TOP OF MacCRADY

BLANKET CASING,  
7" SUSPENDED @ 3,500',  
26#, J-55 8rd.

LEACHING STRING,  
4 1/2" SUSPENDED @ 4,150'  
11.6#, J-55 8rd.

T.D. @ 4,200'

NOTES:

1. DEPTHS SHOWN ARE TYPICAL FOR WELLS SOUTHEAST OF SALTVILLE FAULT.
2. ALL DEPTHS AND SIZES ARE APPROXIMATE AND MAY BE REVISED PER FIELD CONDITIONS.
3. CEMENT ALL SET CASING TO SURFACE.
4. HOLE SIZES ≥ CASING DIAMETER +4".

\* IF PRESENT

NO.	REVISION	DATE	APPR.
A	ISSUED FOR REVIEW	06/29/11	-
B	CHANGES	08/31/11	MC
C	CHANGES	12/02/13	DD
D	ADDED DEPTHS ON CASINGS	06/12/14	-

ATTACHED SHEETS:

**UNITEDBRINE**  
SERVICES COMPANY

SCALE: NONE  
DATE: 04/04/11  
APPROVED: TBC/SALTVILLE CO.  
DESIGN BY: J.D. Frazier  
REVIEWED BY:

TBC-SALTVILLE  
WELL SCHEMATIC  
PROPOSED BRINE PRODUCTION WELL

TBC-SALTVILLE

FILENAME - DATE - TIME  
PROPOSED BRINE PRODUCTION WELLING - 04/04/11-15:0

DWG. NO.  
-





## **USC SALTVILLE BRINE, LLC**

**4800 SAN FELIPE  
HOUSTON, TEXAS 77056  
MAIN OFFICE: (713) 877-2600**

**June 18, 2014**

**Delivered Via Email**

**[Bennett.James@EPAMail.EPA.gov](mailto:Bennett.James@EPAMail.EPA.gov)**

**Mr. James C. Bennett, Environmental Engineer  
United States Environmental Protection Agency  
Ground Water and Enforcement Branch  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029**

**RE: UIC Permit Number VAS3G931BSMY**

**Dear Mr. Bennett:**

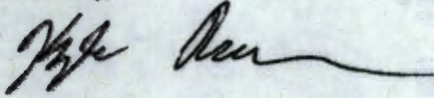
**We are in receipt of the modified UIC Permit with the effective date of May 29, 2014. I have read the modified permit document and am personally familiar with the terms and conditions of the permit. As President, I hereby authorize the following specific individuals to sign permit documents and submissions as representatives of this company:**

- **Scott Whitelaw, VP EHSS, Texas United Corporation**
- **Kathy Gillies, Secretary**
- **Stacey Owens, Treasurer**
- **Ernest C. Sands, II, Saltville Plant Manager**
- **Roscoe D. Call, Saltville Brine Field Manager**



Mr. James Bennett - EPA  
June 18, 2014

Sincerely,



Kyle Rash, President  
USC Saltville Brine, LLC  
4800 San Felipe  
Houston, Texas 77056-3908  
Office: (713) 877-2601  
[KRash@UnitedSalt.com](mailto:KRash@UnitedSalt.com)

Cc Via Email:

Stephen Platt, [Platt.Steve@EPA.gov](mailto:Platt.Steve@EPA.gov)  
Jim O'Donnell, [JODonnell@UnitedSalt.com](mailto:JODonnell@UnitedSalt.com)  
Scott Whitelaw, [SWhitelaw@TUM.com](mailto:SWhitelaw@TUM.com)  
Mark Cartwright, [MCartwright@UnitedBrine.com](mailto:MCartwright@UnitedBrine.com)  
Kathy Gillies, [KGillies@TUM.com](mailto:KGillies@TUM.com)  
Stacey Owens, [SOwens@TUM.com](mailto:SOwens@TUM.com)  
Dave Dickehut, [DDickehut@UnitedBrine.com](mailto:DDickehut@UnitedBrine.com)  
Ernest Sands, [ESands@UnitedSalt.com](mailto:ESands@UnitedSalt.com)  
Roscoe Call, [RCall@UnitedSalt.com](mailto:RCall@UnitedSalt.com)  
Kathy Dubiel, [KDubiel@UnitedSalt.com](mailto:KDubiel@UnitedSalt.com)  
Eileen Rangel, [ERangel@TUM.com](mailto:ERangel@TUM.com)  
Joseph Vance, [JVance@RaeganEngineering.com](mailto:JVance@RaeganEngineering.com)





**UNITED SALT CORP.**

**USC Saltville Brine, LLC**

4800 San Felipe  
Houston, Texas 77056  
Main Office: (713) 877-2600

November 20, 2013

Delivered Via Fedex

Mr. James C. Bennett, Environmental Engineer  
United States Environmental Protection Agency  
Ground Water and Enforcement Branch  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

**RE: Limited Liability Company Name Change – UIC Permit Number VAS3G931BSMY; Bond Rider**

Dear Mr. Bennett:

USC Saltville Brine, LLC, formerly Texas Brine Company Saltville, LLC, previously submitted a name change request to your office. Please find enclosed Bond Rider No. 2 for Surety Performance Bond No. RLB0010725 evidencing the new name of the principal as USC Saltville Brine, LLC.

Sincerely,

A handwritten signature in blue ink, appearing to be "Mai Huynh", written over a horizontal line.

Mai Huynh, Esq.

Enclosure



BOND RIDER NO. 2

Attaching to and forming part of Surety Performance Bond No. RLB0010725, effective August 28, 2007, on behalf of Texas Brine Company Saltville, LLC as Principal, in favor of U.S. Environmental Protection Agency as Oblige, issue by RLI Insurance Company as Surety, in the amount of Three Hundred Fifty Thousand and No/100 Dollars (\$350,000.00).

It is understood and agreed that effective July 8, 2013, the name of the principal is amended to read:

**USC Saltville Brine, LLC**

All other conditions and terms to remain as originally written or previously amended by rider.

Signed, sealed and dated this 14<sup>th</sup> day of November, 2013.

USC Saltville Brine, LLC

Principal

By: CB Gillies

CB Gillies Secretary  
(Printed Name & Title)

RLI Insurance Company  
8 Greenway Plaza, Suite 400  
Houston, TX 77046

Surety

By: Robbie Duxbury  
Robbie Duxbury, Attorney-in-Fact







RLB0010725

RLI Surety  
A Division of RLI Insurance Company

## POWER OF ATTORNEY

### RLI Insurance Company

#### **Know All Men by These Presents:**

That the RLI INSURANCE COMPANY, a corporation organized and existing under the laws of the State of Illinois, and authorized and licensed to do business in all states and the District of Columbia does hereby make, constitute and appoint: ROBBIE DUXBURY in the City of HOUSTON, State of TEXAS, as Attorney-in-Fact, with full power and authority hereby conferred upon him to sign, execute, acknowledge and deliver for and on its behalf as Surety and as its act and deed, all of the following classes of documents to-wit:

\$350,000.00

Indemnity, Surety and Undertakings that may be desired by contract, or may be given in any action or proceeding in any court of law or equity; policies indemnifying employers against loss or damage caused by the misconduct of their employees; official, bail and surety and fidelity bonds. Indemnity in all cases where indemnity may be lawfully given; and with full power and authority to execute consents and waivers to modify or change or extend any bond or document executed for this Company, and to compromise and settle any and all claims or demands made or existing against said Company.

The RLI INSURANCE COMPANY further certifies that the following is a true and exact copy of a Resolution adopted by the Board of Directors of RLI Insurance Company, and now in force to-wit:

"All bonds, policies, undertakings, Powers of Attorney, or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys-in-Fact or Agents who shall have authority to issue bonds, policies, or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers-of-Attorney, or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

IN WITNESS WHEREOF, the RLI Insurance Company has caused these presents to be executed by its PRESIDENT with its corporate seal affixed this

ATTEST:

Jean M. Stephenson  
CORPORATE SECRETARY

State of Illinois )  
County of Peoria )

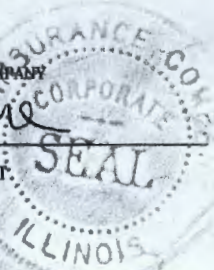
SS



RLI INSURANCE COMPANY

Michael J. Stone  
PRESIDENT

PRESIDENT



On this 14 day of November 2013 before me, a Notary Public, personally appeared Michael J. Stone and Jean M. Stephenson, who being by me duly sworn, acknowledged that they signed the above Power of Attorney as President and Corporate Secretary, respectively, of the said RLI INSURANCE COMPANY, and acknowledged said instrument to be the voluntary act and deed of said corporation.

Jacqueline M. Bockler  
Notary Public



SPA027 (03/11)





## **USC Saltville Brine, LLC**

4800 San Felipe  
Houston, Texas 77056  
Main Office: (713) 877-2600

January 21, 2014

Delivered Via Email with Read Receipt Requested  
[Bennett.James@EPAMail.EPA.gov](mailto:Bennett.James@EPAMail.EPA.gov)

Mr. James C. Bennett, Environmental Engineer  
United States Environmental Protection Agency  
Ground Water and Enforcement Branch  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

**RE: UIC Permit Number VAS3G931BSMY**  
UIC Permit Application, dated September 1, 2011  
Comment Letter from EPA, dated September 6, 2012

Dear Mr. Bennett:

This letter is in response to your letter sent September 6, 2012 regarding the application by USC Saltville Brine, LLC (then Texas Brine Company Saltville, LLC) to expand its operations at the Saltville facility and to increase the total number of wells to seventeen. USCSB contracted the professional services of Mr. Gabriel Fernandez to respond formally to your inquiry.

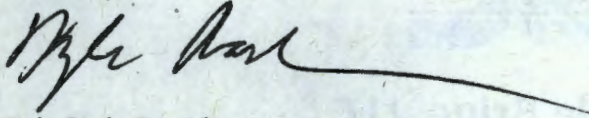
Mr. Fernandez is a geotechnical engineer with a considerable amount to engineering experience in underground mining, specifically at the Saltville facility. Mr. Fernandez and Alfonso Castro, his associate, have evaluated the facilities and have afforded their comments in the report attached hereto.

We believe that this response will address your request satisfactorily. Should you have any questions or need additional information, please contact Joseph Vance by email, [JVance@RaeganEngineering.com](mailto:JVance@RaeganEngineering.com), or phone, 276-210-1756.



Mr. James Bennett - EPA  
January 21, 2014

Sincerely,



Kyle Rash, President  
USC Saltville Brine, LLC  
4800 San Felipe  
Houston, Texas 77056-3908  
Office: (713) 877-2601  
[KRash@UnitedSalt.com](mailto:KRash@UnitedSalt.com)

Attachments:

Evaluation Report by Gabriel Fernandez and Alfonso Castro, dated January 14, 2014  
15 pages of narrative and 13 pages of exhibits

Cc Via Email:

Stephen Platt, [Platt.Steve@EPA.gov](mailto:Platt.Steve@EPA.gov)  
Jim O'Donnell, [JODonnell@UnitedSalt.com](mailto:JODonnell@UnitedSalt.com)  
Scott Whitelaw, [SWhitelaw@TUM.com](mailto:SWhitelaw@TUM.com)  
Mark Cartwright, [MCartwright@UnitedBrine.com](mailto:MCartwright@UnitedBrine.com)  
Dave Dickehut, [DDickehut@UnitedBrine.com](mailto:DDickehut@UnitedBrine.com)  
Ernest Sands, [ESands@UnitedSalt.com](mailto:ESands@UnitedSalt.com)  
Roscoe Call, [RCall@UnitedSalt.com](mailto:RCall@UnitedSalt.com)  
Eileen Rangel, [ERangel@TUM.com](mailto:ERangel@TUM.com)  
Joseph Vance, [JVance@RaeganEngineering.com](mailto:JVance@RaeganEngineering.com)



**EVALUATION OF SALTVILLE BRINEFIELD GALLERIES IN VIEW OF  
THE BAYOU CORNE, NAPOLEONVILLE DOME BRINEFIELD,  
SINKHOLE**

**PREPARED FOR  
USC SALTVILLE BRINE LLC**

**by**

**Gabriel Fernandez**

**Alfonso Castro**

**Champaign, 14 January 2013**



## **Introduction**

This report has been prepared in response to the United States Environmental Protection Agency Region III inquiry for a review of the Saltville Brinefield, Virginia, operation practices in order to prevent an occurrence similar to the sinkhole that developed in May to August 2012 in the Napoleonville Salt Dome, Assumption Parish, Louisiana. The evaluation and comparison of key elements in both brine fields presented in this report support the conclusion that the geotechnical and operational conditions at the Saltville Brinefield are completely different and significantly more favorable than those at the Napoleonville Dome, and thus the potential for a sinkhole formation in Saltville is practically nil.

Tremors and gas bubbling developed in April and May 2012 in the near vicinity of brine Well Oxy-Geismar 3 (OxyG3), in the Napoleonville Dome, Louisiana, which is operated by Texas Brine Co (TB). The first evidence of a sinkhole adjacent to Well OxyG3 was observed on 3 August 2012. Texas Brine had also been operating several brine caverns in their Saltville, Virginia brinefield since 2007. Presently, the new Saltville operator, USC Saltville LLC has applied to increase the number of wells in the Saltville Brinefield. As part of the permit, the US EPA has requested an assessment of the potential for the development of a sinkhole as it has occurred at the Napoleonville Dome Brinefield. This report addresses specifically the potential for the development of this type of sinkhole in the vicinity of Gallery 13-14, and later, for sinkholes of more general nature in the overall Saltville Brine Field. For this purpose, a review was carried out to evaluate key parameters controlling the stability of Saltville Gallery 13-14 and Napoleonville Dome Cavern Oxy-Geismar 3. The key parameters were then compared in order to establish the potential for similar behavior. These parameters include:

- Geological setting
- Geotechnical in situ conditions
- Operational parameters and history
- Monitoring program



### **Saltville Gallery 13-14 Topography and Geology**

The Saltville Brinefield is located in western Virginia, one mile SW from the town of Saltville. A topographic map with the location of the cavern wells and other civil works is shown in Figure 1. The location of Gallery 13-14 is highlighted in the map. The terrain at the Saltville Brinefield is basically hilly and the wellheads of Gallery 13-14 are located on a slope with an average inclination of 1V:3H, about 18°.

#### **Geological Conditions -**

The salt deposits near the town of Saltville are the only known deposits of rock salt in the Southern Appalachian Basin, which is mostly Mississippian in age (~340 Myr). They occur in the MacCrady Formation and to a lesser extent in the younger Little Valley Formation. The salt bearing member of the MacCrady Formation along with other sedimentary strata has been folded into a northeast-trending recumbent syncline known as the Greendale Syncline. The forces that caused the fold also created the Saltville Thrust Fault, which strikes parallel to the axis of the syncline, approximately NE.

At Gallery 13-14, the depth of the top of the MacCrady salt-bearing member varies between 700 ft to 900 ft, approximately (Figure 3 shows that the top of the formation dips to the SW at the Gallery); and the bottom of the salt-bearing member at Gallery 13-14 is at a depth of about 3500 ft, as determined by the borehole cores of Well #8, 700 ft from Well 13 along the approximately NE strike of the syncline (Figure 1).

In the salt-bearing member, drill hole cores indicate that the salt occurs as zones of tectonic salt breccia, with the salt completely filling the voids of the brecciated rock. The breccia bears intrusive relations to the surrounding formations, but there is little if any original bedded salt. The rock salt in the upper limb of the syncline contains abundant clasts of red, green, and gray MacCrady shales and of associated anhydrites, limestones, and dolomites, suspended in a matrix of salt that is reddened by fine dissemination of MacCrady red clay. The Gray Salt, in the lower limb, is also tectonically brecciated but contains only anhydrite and gray shale clasts.



The salt content of the MacCraday Salt is relatively variable. Cores of wells drilled before 2000 indicate that 60 to 75 percent of the rock in the MacCraday Salt member is salt. However, the cores of recently drilled Well 1 suggest a lower salt fraction of 30% to 50%. And the present height of rubble in Gallery 13-14 indicates a similar salt fraction of only about 40 percent. A review of rubble heights in Gallery 13-14 at different times confirms the relatively wide variability in the salt content of the member. The large amount of rubble, helped by its bulking, result in relatively short open cavern heights above the top of rubble.

The Saltville Fault is relatively planar, with an approximately SE dip of  $11^{\circ}$  -  $12^{\circ}$ . Above Gallery 13-14, the depth of the fault is 350 to 365 ft. There is no evidence of displacement along the Saltville Fault occurring during the last 100,000 years, or earthquake activity associated with the Saltville Thrust Fault since 1758.

The Greendale Syncline and the Saltville Fault pushed older Ordovician and Cambrian dolomites, shales and limestones (600 Mir, approximately) over the younger deformed salt-bearing MacCraday Formation, as shown in Figure 2. The Saltville Thrust Fault separates the MacCraday Formation from the older units above and is marked by the contact between the Honaker Dolomite (Cambrian) above and the MacCraday Formation (Mississippian) below. The older formations are massive and the quality of the rock for cavern roof support above the salt roof is adequate.

A geological section N53W through Gallery 13-14 along the dip of the overlying Saltville Fault is presented in Figure 3. The roof of Gallery 13-14 is presently located at a depth of 1450 ft below ground surface (elevation +635 ft above mean sea level), with about 600 ft of MacCraday salt above the roof, as shown in Figure 3. Recently obtained information indicates that the original cavern bottom (operations started in around 1956) is at a depth below ground surface of approximately 2098 ft in Cavern 13 and 2083 ft in Cavern 14 ft. (elevations 86 ft and 71 ft below sea level, respectively).

### **Napoleonville Dome, Louisiana**

The August 2012 Bayou Corne sinkhole is located in the Napoleonville Dome Brinefield to the northeast of brine Well Oxy-Geismar 3, and its cavern is one of many brine and storage



operations in the Napoleonville Salt Dome and one of three caverns operated by Texas Brine for the Oxy Chemical Corporation. At the time of the incident, Texas Brine was also operating the Saltville Brinefield in Virginia.

The Napoleonville Dome is located in Assumption Parish, Louisiana, under and west of the town of Napoleonville. Figure 4 shows the general location of the dome. The three Texas Brine wells, Oxy Geismar 1, 2, and 3, (OxyG1, 2 and 3, respectively), indicated in Figure 4, are near the NW perimeter of the dome. The Bayou Corne Sinkhole is the feature just north and west of Well OxyG3. Figure 4 also shows the relatively large number of wells (indicated by tower symbols) drilled for brining or storage into the Napoleonville Dome. Figure 5 is a close up of the area, from a photo taken between May and August 2012, before the Bayou Corne sinkhole was visible on the ground surface. The figure includes the Texas Brine and neighboring brine wells (yellow circles) and water wells (blue circles). The triangles and diamonds in Figure 5 are points where gas bubbling had been reported at the time of the photo. Since the sinkhole creation, about 70 active bubble sites have been detected, extending over an area of approximately two square miles around the sinkhole. Figure 6 is a close up photo of the sinkhole area in Figure 4 that offers a detailed view of the sinkhole.

Figures 4 to 6 do not include the relatively large number of oil and gas extraction wells drilled around the perimeter of the dome. Photos and maps found during the literature search indicate a significant number of oil or gas wells in the general vicinity of the perimeter of the Dome. One air photo was found which shows the presence of about 20 abandoned wells encircling Well OxyG3, at a distance of about 1500 ft. The purpose of the wells is believed to be related to oil and gas exploration.

### **Bayou Corne Sinkhole Topography and Geology**

The topography above the Texas Brine caverns, including the surroundings of the Bayou Corne sinkhole, is flat-lying with large marsh areas, typical of Bayou terrain.

The Napoleonville salt dome lies within the Coastal Plain physiographic province, which is locally characterized by flat-lying Pleistocene to recent unconsolidated deltaic sediments. The source bed for the salt dome is the Luann Salt, of Jurassic age, estimated to lie to a depth of



30,000 to 47,000 ft below ground surface. The upward movement of the dome through the overlying sediments may have begun during the Oligocene Period. The horizontal cross section of the Napoleonville Dome is approximately elliptical, with major and minor diameters of about 7000 ft by 5000 ft, respectively. The Napoleonville Dome is small in dimension when compared to the average south Louisiana salt domes that extend for miles in diameter. A cap rock approximately 350-375 ft thick overlies the dome, and is in turn covered by unconsolidated alluvial silts and clays of about 350-375 ft in thickness.

The salt dome is surrounded by Pleistocene and Miocene age unconsolidated sediments with a thickness in excess of 30,000 ft, which consist mainly of sands, silts and clays. The upward moving salt dome intruded the overlying sediments dragging the adjacent layers upward along the edge of the dome, creating traps for oil and gas deposits. Radial faults are common on the flanks of Gulf Coast salt domes. The water-saturated alluvial sediments over the cap rock act as an aquiclude around the Bayou Corne sinkhole. Approximately 47 wells have been drilled through the alluvial layer in the area after the occurrence of the sinkhole, in order to evacuate gas that has accumulated in bubbles at the bottom of the alluvial layer. The maps of gas bubbling detected on the ground surface after the formation of the Bayou Corne Sinkhole show gas exiting at locations more than 2000 ft away from the sinkhole. Natural gas bubbling around the dome preceded the sinkhole.

The salt in south Louisiana is thin-bedded halite, with about 2 to 5 percent anhydrite. As the salt dome rose, it flowed into complicated fold patterns with vertical axes that resemble the folds in window drapes. The stems of the domes typically exhibit verticality in their structure with an enhanced salt mass permeability in the vertical direction.

The structural features of salt domes can be subdivided into those within the salt stock and those external to the salt and in the surrounding sediments. The term "dome" refers to the whole structure and "stock" strictly to the salt.

**Internal Salt Dome Structures** - The structure in salt stocks has been likened to that formed by drawing the center of a flat handkerchief up through a finger ring, producing numerous, radially-distributed, vertical folds. The beds near the edge of the dome tend to be parallel to the edge and by shearing and transposition appear simple and homoclinal.



The actual salt structures within the stock are very involute and complex. Sites of original deposition are now distant. Movement has occurred in "pulses" repeated several times, and most of the present structures of the salt are complex. Isoclinal- folded beds are commonplace, but difficult to recognize from only drill hole cores.

**External Salt Dome Features** - The external structures are those in the perimeter of the salt domes. They have been extensively studied, since they contain most of the oil-producing formations around the domes. The major external features are: dome, central graben, faults, rim synclines, and unconformities.

The most obvious feature is the dome, commonly 5 to 10 miles in diameter, that interrupts both the gulf-ward regional dip of the sediments and their gulf-ward increasing thickness. The structural maps assembled by the New Orleans Geological Society, the Lafayette Geological Society and a number of other authors describe the large variability in shape and dimension of the south Louisiana domes.

Rim synclines are peripheral sinks formed as salt in the mother bed is withdrawn into the stock. The age of the over thickened sediments indicates the time of salt movement. Stretching of the sediments by the up-punch of the salt is largely responsible for the inward-dipping faults and central graben and, with erosion, for the unconformities. Downward sinking of the adjacent sediments, especially into the adjacent rim synclines, forms outward-dipping faults marginal to the stock. Regional faults are common associates and may be sub-parallel to the original boundaries of the basin, to the wedges of sedimentation, or to the present coastlines.

The above summary of the geology at the two sites shows that their geological characteristics are completely different.

#### **Geotechnical Conditions -**

The solution operations by Texas Brine in wells OxyG1, 2, and 3 have shown a very small amount of insolubles in the salt, about 2%, a typical value in the South Louisiana domes. The Napoleonville Dome is surrounded by a significant number of oil and gas-bearing formations, which have been exploited for quite some time.



The detailed structure of the Napoleonville Dome and adjacent formations in the vicinity of the Bayou Come sinkhole has been studied by means of a number of geophysical surveys, including a detailed 3D seismic reflection survey carried out in April 2013. Our analysis below is based almost entirely on the April 2013 geophysical report and the Geologist interpretations presented there. It is beyond the scope of our study to independently evaluate the geophysical cross sections or the features highlighted by the Geologist in the geophysical cross sections that will be introduced in the paragraphs below.

Figure 7 shows the location of the stratigraphic cross sections presented in Figure 8 (obtained as part of the 3D geophysical study). The sections were taken at the edge of Cavern Oxy G3 and near the south and east edges of the sinkhole. The edge of salt is indicated in the cross sections in Figure 8 by green or orange continuous lines. The depth and the horizontal dimensions are shown to the left and at the top of each of the cross sections. The figures clearly show the upward folded sedimentary layers in contact with the perimeter of the Napoleonville dome. The vertical dotted line in the W-E section in Figure 8 is the alignment of Well OxyG3. The cavern was dissolved between depths of 3450 ft and 5850 ft. A number of normal faults across the sediment, some reaching the edge of the dome, are also shown.

A schematic cross section with the interpreted edge of salt and the location and dimensions of Cavern OxyG3 prior to 2008 is shown in Figure 9. The cavern's vertical cross section is that of a truncated cone with relatively smooth walls and top and bottom diameters of 150 ft (3450 ft deep) and 300 ft (5850 ft deep), respectively. Before 2008, the distance of the outer wall of Cavern OxyG3 to the edge of salt was estimated to increase from 600 ft at the top of Cavern to 900 ft at the bottom as shown in Figure 9. More detailed geophysical surveys were carried out after the August 2012 sinkhole. Based on this information, the Louisiana Department of Natural Resources concluded that at the time of the onset of the sinkhole, the minimum distance of the west wall of Cavern OxyG3 to the edge of salt was about 150 ft.

During the brining operations at Cavern OxyG3, the Hooker oil well was drilled directionally to tap the oil of the Big Hum Formation. Oil extraction operations at the Hooker Well were terminated and the well was plugged before Well OxyG3 was plugged. Figure 10 shows in plan the location on the ground surface of the Hooker Well head. The figure also shows the location of the cross sections in Figure 11, which intersect the oil well and Cavern OxyG3. The cross



sections in Figure 11 show the stratigraphy of the sedimentary formations surrounding the Dome, with the Big Hum formation highlighted. In the cross sections, the distance from the edge of the Big Hum to the cavern axis ranges between zero ft in the left cross section in the figure to 500 ft in the right cross section. We have been informed that the final formation pressure in the Big Hum, when the oil company plugged Hooker Oil Well after operations ended, was 900 psi at the elevation of the bottom of the cavern.

### **In Situ Operating Conditions and Activities in the Vicinity of the Galleries**

#### **Saltville Gallery 13-14 -**

First and foremost, there are no operational features, including wells, other galleries, or the sinkhole within at least 600 ft from the walls of Gallery 13-14 that can negatively impact the stability of the gallery. There are no other brine wells other than those owned and operated by the owner of the Saltville Brinefield. Although, the MacCradie salt bearing member is a conglomerate, the salt mass can be considered homogenous at the scale of the dimensions of the gallery. Any structural analysis may assume a homogeneous salt mass around the Gallery.

Wells 13 and 14 started dissolution as a gallery in 1956, injecting in one well and recovering from the other. Operations stopped in about 1972 and the wells were plugged. The caverns were re-entered in 2006 through two new wellbores, one for each cavern. The new wells have been operated continuously. Since 2012, fresh water is injected into Well 13B and brine is recovered through Well 14A, with well head injection pressures of 300-400 psi, and injection rates of about 200 gpm initially, and 120 gpm since July 2012. The closest operation to Gallery 13-14 takes place in Brine Gallery 9-17. The distance between the nearest wells in the two galleries is about 650 ft, and the estimated minimum distance between the edges of the galleries is about 350 ft.

#### **The Saltville Sinkhole -**

In 1960, a sinkhole about 600 ft in diameter (the Saltville "Large Sinkhole") occurred over the gallery developed by Wells 1 to 4, about 600 ft away from Gallery 13-14. The Large Sinkhole is shown in plan view in Figure 1. The original bottom of the caverns at these wells is believed to



be about 1250 ft, deep (elevation 670 ft above sea level), but salt extraction probably had raised the rubble several hundred feet before the collapse, since the Saltville salt contains a large amount of impurities. Several factors combined to create the sinkhole including:

- narrowly spaced wells, about 70 feet between one well and the next one;
- the salt in the gallery was mined up to the top of good quality salt, leaving a potentially unstable cavern roof
- development of an unsafely wide Gallery arching span, probably 500 to 600 ft, which has been found to be the upper limit of a safe span for salt solution caverns, unless an adequately thick and competent salt mass is present at the cavern roof.
- poor understanding of the implications of casing or tubing distress near the top of the Gallery with regard to cavern structural safety;
- lack of adequate monitoring. We are not aware of any records of subsidence surveys, sonar soundings or downhole geophysical logs performed during the development of the gallery;
- In addition, the sinkhole is in the alignment of a small valley (Figure 1), which presently is showing subsidence unrelated to brining operations. It is possible that, over geologic times, water infiltration dissolved the upper part of the MacCraday salt member under the valley and weakened the capacity of the salt roof over Gallery 1 to 4.

None of the elements that contributed to the formation of the Saltville Large Sinkhole exists in the present Saltville caverns.

The maximum span of Gallery 13-14 is presently about 320 ft and the cavern roof is 1450 ft deep, with a salt cover of about 600 ft. The distance from the crater of the 1960 Sinkhole to Well 14A, the nearest well in Gallery 13-14 is about 700 ft. The bottom of the sinkhole is estimated to be about 1250 ft deep and the top of rubble is probably several hundred feet above. Thus, the total distance to the sinkhole is large enough to assure that the sinkhole does not presently affect the structural stability capacity of Gallery 13-14.

#### Cavern Oxy Geismar 3 -

The single most important operational features of Cavern OxyG3 are:

- we understand that the salt wall left by the cavern against the surrounding unconsolidated sedimentary formations has been estimated by the DNR to be at least



150 ft thick,

- the very low formation pressure left in the Big Hum oil bearing formation after oil extraction, 900 psi, compared the Cavern OxyG3 bottom pressure, 2800 psi, and
- the presence of relatively soft unconsolidated oil and gas bearing sediments around the perimeter of the dome.

A conceptual model of the cavern and its location is presented in Figure 12. Cavern OxyG3 started operations in 1982 and was plugged in 2011. The cavern was operated with a single well, with injection pressures of 750 psi and injection rates of 1220 gpm. The formation temperature at the cavern is about 95 to 100° F, while the temperature of the injected water was about 70° F.

These operational features are totally different from those presently implemented at the Saltville Brinefield.

### **Geotechnical In Situ Conditions**

Important elements that contribute to the safety, or lack of it, of the Saltville and OxyG caverns are presented comparatively in this section.

#### **Salt Cover Above Roof and Around Walls of Gallery 13-14 -**

The roof of Cavern 13-14 in the MacCrady salt member is presently under about 600 ft of salt. The geological studies have concluded that the salt is massive with no cracks or faults of significant extent. Furthermore, the rock above the MacCrady salt member, although interrupted by the Saltville Thrust Fault is relatively massive and sound. Also, the salt around the Saltville caverns is massive, with the feature nearest to the walls of Gallery 13-14 about 600 ft away, as discussed previously.

Cavern OxyG3 presents an amply adequate salt roof, with a thickness to the cap rock of about 2900 ft. The distance between the cavern walls and the walls of Cavern OxyG2 the nearest cavern, is estimated to be approximately 400 ft, which is appropriate for caverns in South Louisiana salt domes.



On the other hand, the distance from the west wall of Cavern OxyG3 to the edge of salt in the Napoleonville dome, provided a lateral salt cover of about 150 ft.

#### Percentage of Insolubles –

The MacCrady Salt Member contains a very large and variable amount of insolubles through the depth of the deposit about 40% on average. The bulking of these insolubles during solutioning results in larger volumes of rubble that tend to fill considerable portions of the lower cavern space. Figure 3 shows a cross section across Gallery 13-14 at two different times, 2000 and 2012. The cavern-rubble height ratio was 1:1.5 in 2000 and decreased to 1:4 in 2012. The large rubble fraction provides support to the cavern walls, and maintains a relatively short cavern height, thus promoting cavern wall stability.

In contrast, the fraction of impurities in the OxyG caverns is quite small, only 2%, and like most other caverns in the South Louisiana domes, the caverns tend to be quite elongated vertically and cannot count on a rubble pile for wall lateral support.

#### Strength and Creep of the Salt Around the Caverns -

Figure 13 summarizes the strength envelopes of a number of salt deposits, including sedimentary and dome salts. The undrained strength of the Weeks Island Dome salt, another South Louisiana Dome, is also included. The strength envelopes show that, within the variability of the different salts, their shear strength envelopes are similar at a given confining stress.

Although the strength envelopes of the salt at the Napoleonville and Saltville brinefields are essentially equal, the larger depth of the Napoleonville caverns results in a larger creep-induced closure of the cavern, which in turn increases the cavern pressure after plugging, potentially triggering a larger hydraulic gradient across the salt wall at the edge of the dome.



#### **Brine Pressure Differential -**

The Saltville Gallery 13-14 is essentially operated at full brine wellhead (the brine level is approximately at ground surface), so there is no significant excess brine pressure to the surrounding ground. All the neighboring caverns are also operated at full brine head so there is only a nominal hydraulic gradient from one gallery to another, and it is also nominal towards the Saltville Sinkhole.

In Cavern OxyG3, the estimated gradient from the cavern to the edge of salt is considerably higher.

#### **Cavern Fluid Temperature And Cavern Distress After Plugging -**

The formation temperature in the Saltville Brinefield is about 70° F, to 75° F quite close to the temperature of the injected fresh water. Moreover, the more than 20 caverns in the original Saltville Field, which include those in the adjacent Storage Field, were plugged in 1972. None of the caverns have shown surface features associated with cavern distress, much less collapse. Some of the caverns, including Gallery 13-14, were re-entered about 25 years later and excess wellhead internal pressures of about 400 psi to 600 psi were measured. The residual cavern pressures encountered could be explained by cavern creep increasing the fluid pressure to eventually reach stability. None of the caverns reentered seemed to have suffered hydrofracturing on account of the moderate increase in cavern pressure.

#### **Monitoring of Cavern Performance**

The Saltville caverns, including Gallery 13-14, have in place a monitoring program that includes surface subsidence survey nets over each Gallery, to detect local cavern-induced subsidence within 500 ft to 700 ft around the Galleries. The subsidence surveys are carried out biannually. Regular sonar soundings are also carried out. We consider that the present monitoring program is sufficient to provide early warning of important cavern distress and allows adequate time to take preventive measures, should signs of distress occur.



### **Potential for Sinkhole Formation at Other Saltville Brine Caverns**

Most of the caverns at the Saltville Brinefield were plugged 25 years ago and remain dormant. Besides Gallery 13-14, only Gallery 9-17 and new Gallery 1-131 are currently in mining operation. The comparative evaluation carried out between the OxyG3 Cavern and Gallery 13-14 can be extended to all other caverns presently in operation in the Saltville Brinefield, including galleries 9-17 and 1-131, and those proposed, because:

- the geology through the Saltville field is basically the same, for all caverns,
- the salt mass beyond the walls of all galleries at Saltville is wide (about 700 ft) and of good quality,
- the shortest distance to an important discontinuity in any of the Saltville caverns is between Well 9 and the Saltville Sinkhole chimney, about 700 ft, which is considered to be adequate, since Brine Gallery 9-17 does not seem to be affected by the stress relief caused by the sinkhole.

The potential for a sinkhole triggered by roof collapse in the various Saltville galleries has been studied by the senior author (Fernandez 2001) and is presented in a number of reports. The analyses have shown that the operating caverns have appropriately high factors of safety under all potential modes of failure considered.

As in Gallery 13-14, galleries 9-17 and 1-131 also have a monitoring program that includes subsidence survey nets and regular subsidence surveys and sonar soundings. Recently, Well 9 was worked-over and the program of sonar surveys was started again after some years. The results of the sonar survey after the recent work over show a stable cavern migrating upwards, not laterally, in the same manner that Gallery 13-14 has progressed. Gallery 1-131 is just starting, so there is no need yet for a quantitative analysis of structural stability.

### **Conclusions**

A review of key geological, geotechnical and operating parameters in the vicinity of Saltville Cavern 13-14, and in Cavern Oxy-Geismar-3 indicates that the conditions at the two sites are fundamentally different and that the potential for the development of a sinkhole triggered by a breach of the walls of Saltville Gallery 13-14, as it occurred in Cavern OxyG3 does not exist.



We have also reviewed the performance of the other brining caverns at the Saltville site, their operating parameters, and the records gathered by their current monitoring programs. We conclude that the potential for the development of a sinkhole caused by wall breach does not exist either.

We also conclude that the potential development of a sinkhole triggered by the more typical mode of roof collapse in the Saltville caverns is nominal. Specifically, none of the elements that contributed to the formation of the Saltville Large Sinkhole exists in the present Saltville caverns.

Furthermore, the monitoring programs in place in the Saltville Brinefield have been designed to provide early warning of impending distress and allow for timely action in order to preclude the initiation of sinkhole development.

The evaluations of the collapse at Cavern OxyG3 were based on the available geologic reports. It is beyond the scope of the present study to independently assess the details of the structure of the salt or of the formations around Cavern OxyG3, or the location of different features in the vicinity.

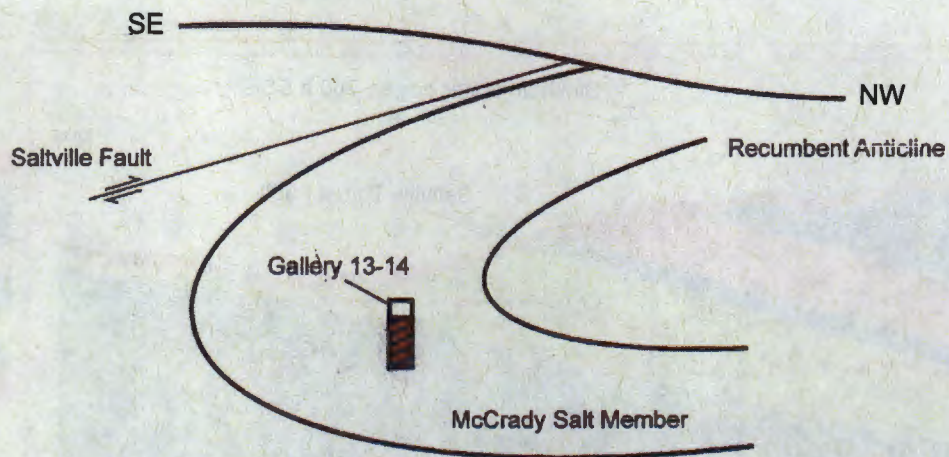
## **References**

- Fernandez, Gabriel, 2001, "Evaluation of Ground Subsidence and Cavern Storage pressures for proposed Saltville Storage Expansion, Caverns 13-14-15", prepared for Virginia Gas Company.
- Fernandez, G., and A. Castro, 2013, "Saltville Brinefield (Texas Brine) Gallery 13-14, Preliminary Structural Evaluation" prepared for USC Saltville Brine LLC.









The salt deposit is part of a recumbent anticline. The Saltville fault overlies the anticline.

Caverns 13-14 are located in the McCrary Salt Member. Their location within the anticline is shown above.

The McCrary Salt Member is a consolidated conglomerate of salt and insolubles resulting from the action of the tectonic forces, with no significant persistent laminations, or weakness planes. For the purpose of cavern stability, the salt mass behaves as a homogenous body.

Figure 2



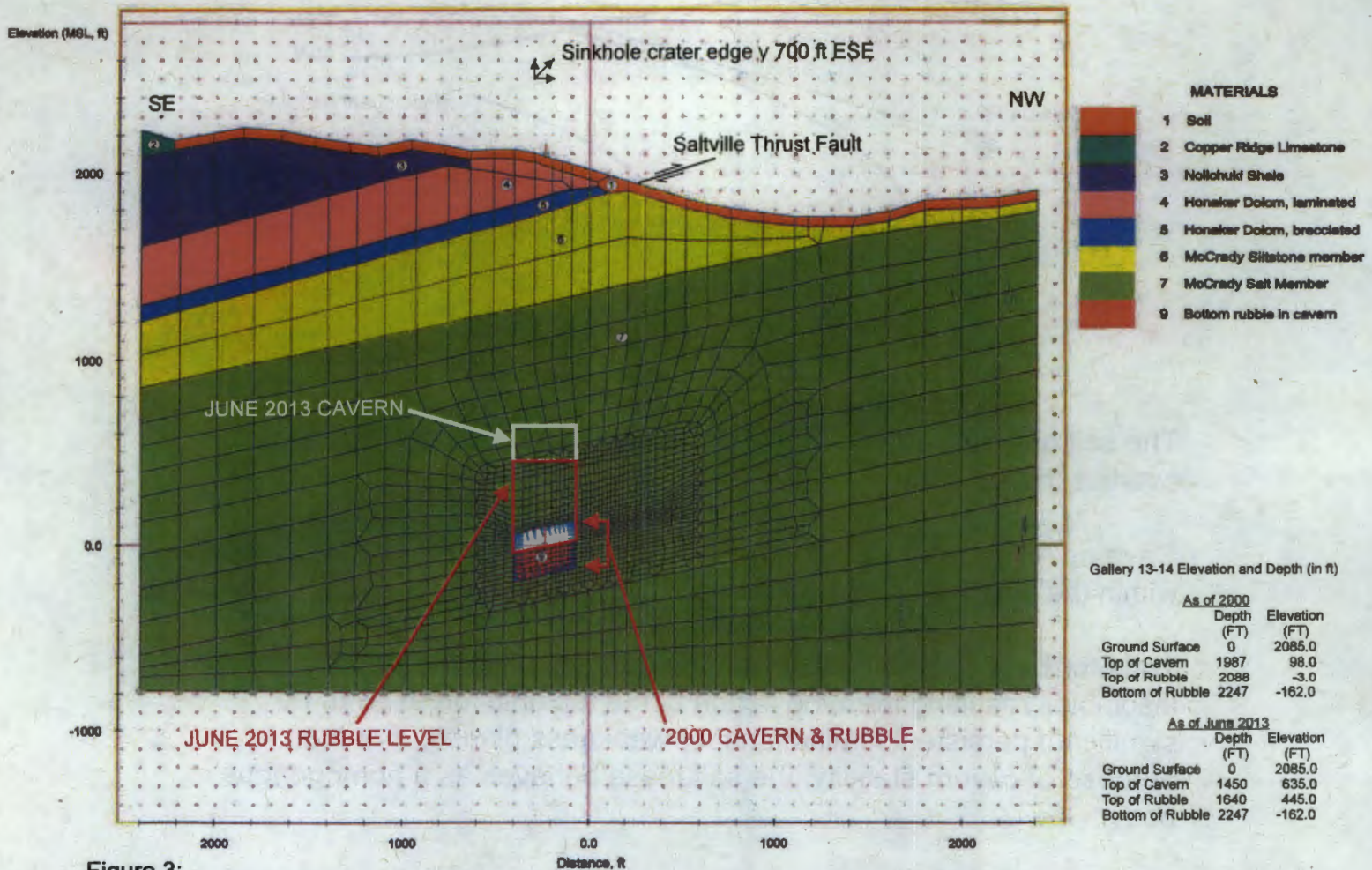


Figure 3: Geological cross section SE to NW through gallery 13-14 - Gallery depth from 2000 and June 2013 sonars of Cavern #14A (Figure taken from FEM analysis of 2001 by GF & AC).





Figure 4: Aerial View of the Napoleon Area. Photo from Google Maps 2013, Map date is 2011

Fig 4





Figure 5: Close-up of Figure 4 showing the oxygen wells before the sink hole





Figure 6: Bayou Corne Sinkhole - Close up of Figure 4.



### 1. OG 3 collapse zone definition and images



**Figure 7: Base Map with Location of Seismic Lines Near OG3 fro Figure 8.**

Fig 7



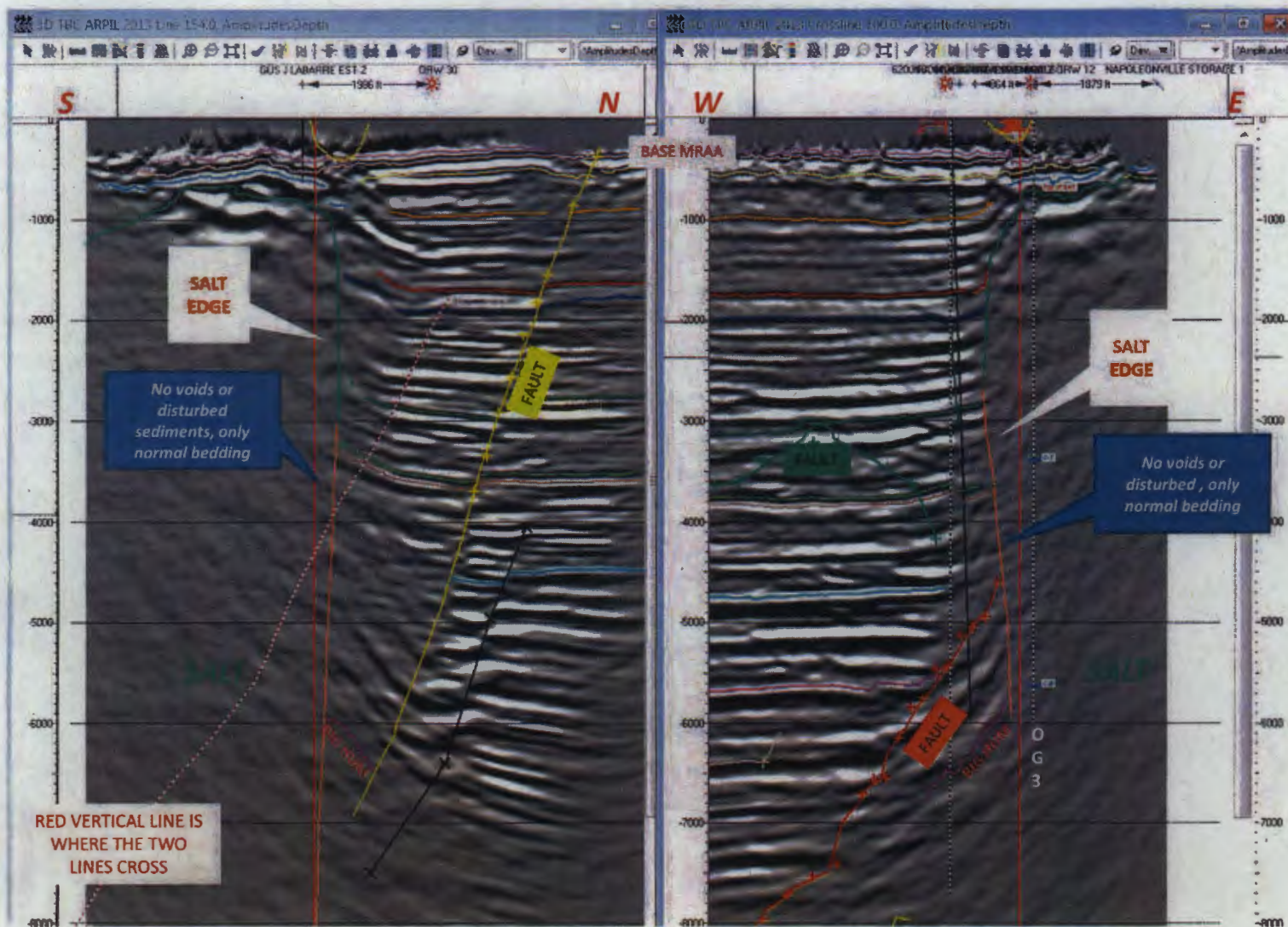
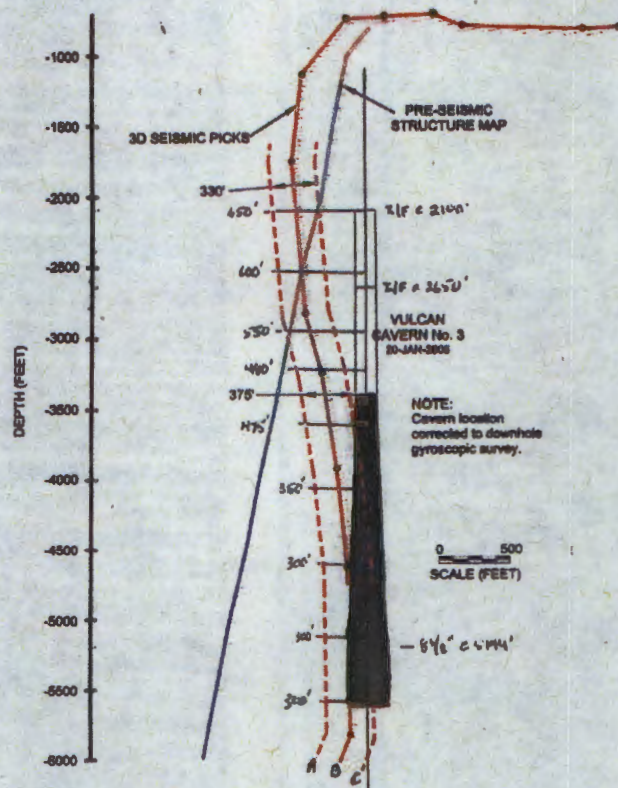


Figure 8: Seismic Reflection Survey Showing Cross Sections Located in Figure 7.



RM-1808-08-001

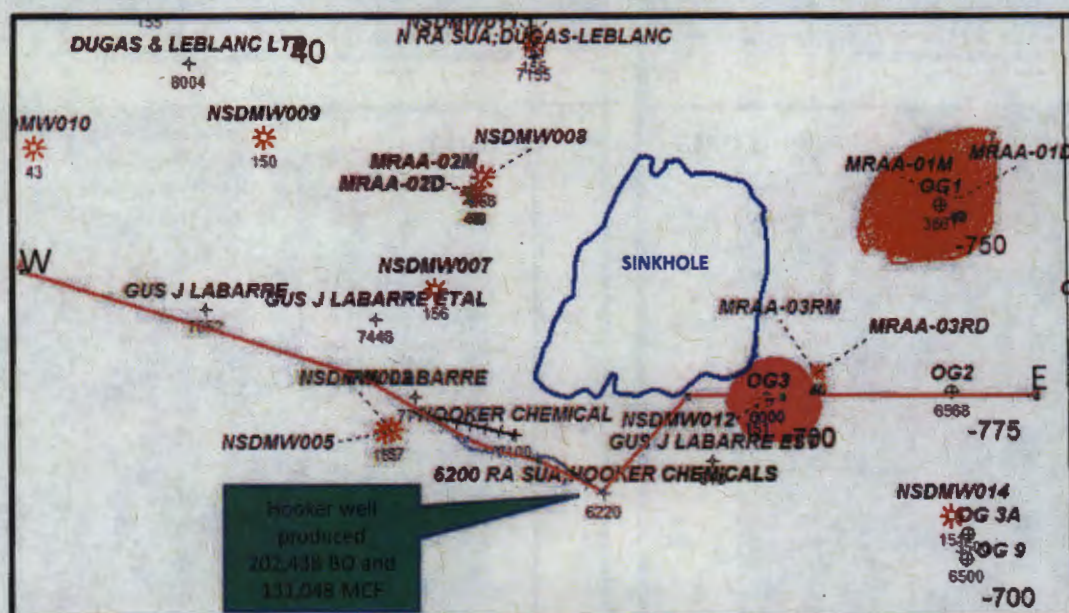


SMRI Bremen conference 1 Oct 2012, Voigt

Figure 9: Cavern OxyG3. Geologist interpretation of the edge of the Napoleonville dome pre and post 2012



4. Are there hydrocarbon zones that could be contributing to the sinkhole and gas in the MRAA? If so, where are they and how large are they?

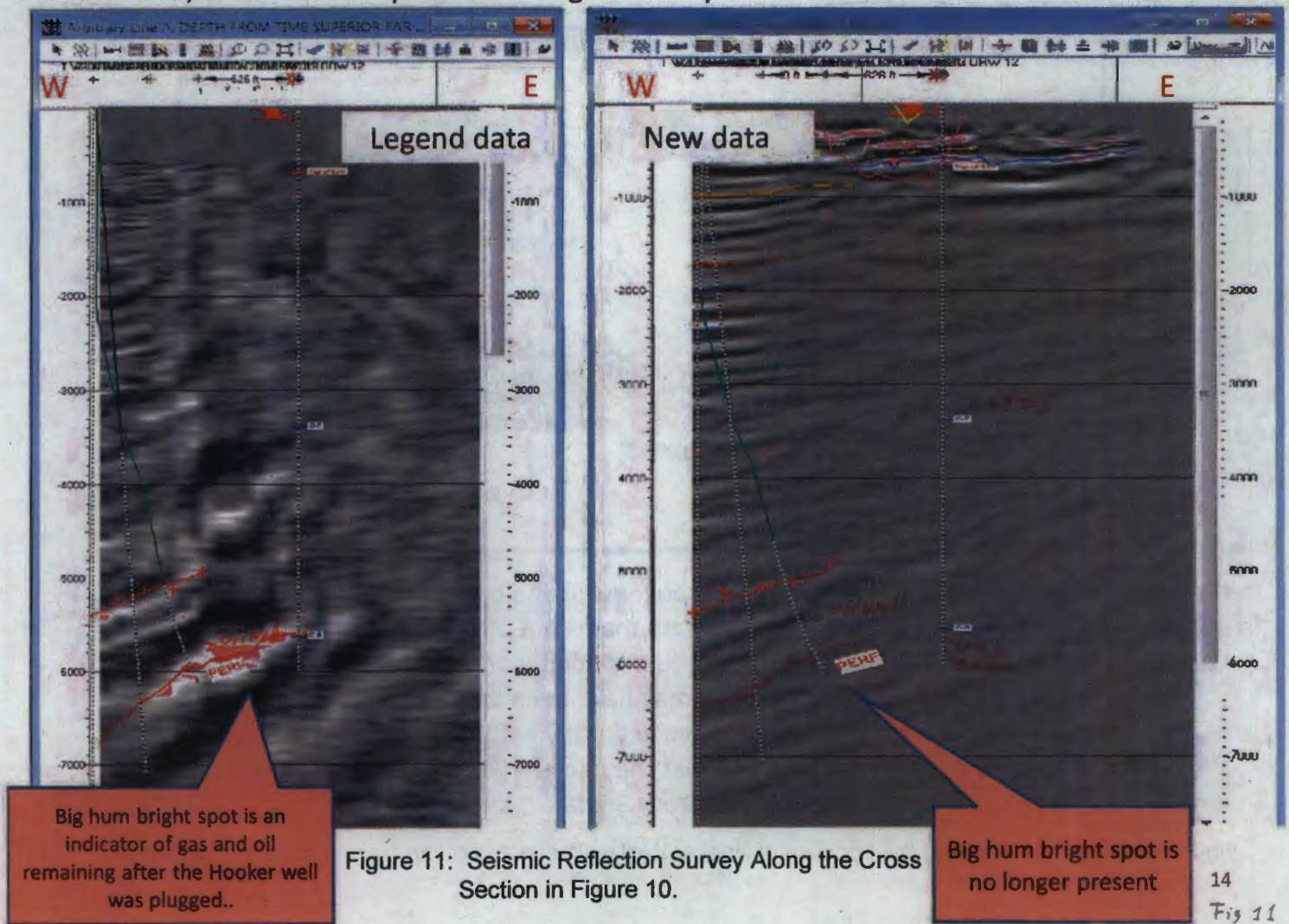


A seismic line (pink) drawn through the Hooker well and cavern clearly shows that there is a large bright amplitude on the Legend data that is not present on the new seismic data. The area of the original Big hum amplitude has been mapped and reservoir analysis will tell how much oil and gas remained and may have been liberated. No other areas within the new 3d have changed. There may have been tiny amounts of oil and gas trapped next to the salt dome, but they are so small that they do not get imaged even by the new high frequency 3d data.

Figure 10: Site Plan Showing the Location of Hooker Well wellhead and of the cross section in Figure 11.



4. Are there hydrocarbon zones that could be contributing to the sinkhole and gas in the MRAA? If so, where are they and how large are they?

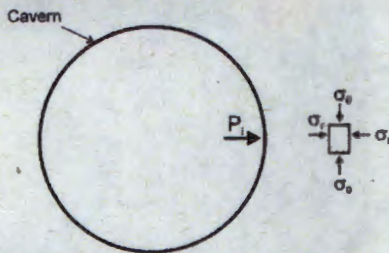






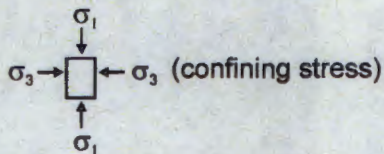


### Stresses in the field:



### Lab: Triaxial tests

Load specimen up to desired  $(\sigma_1 - \sigma_3)$ , or Up to  $(\sigma_1 - \sigma_3)$  sub-failure.



### Definitions of applied shear stress:

$$\tau_{2D} = 0.5 (\sigma_1 - \sigma_3)$$

$$\tau_{3D} = 0.58 (\sigma_1 - \sigma_3)$$

(for the same test)

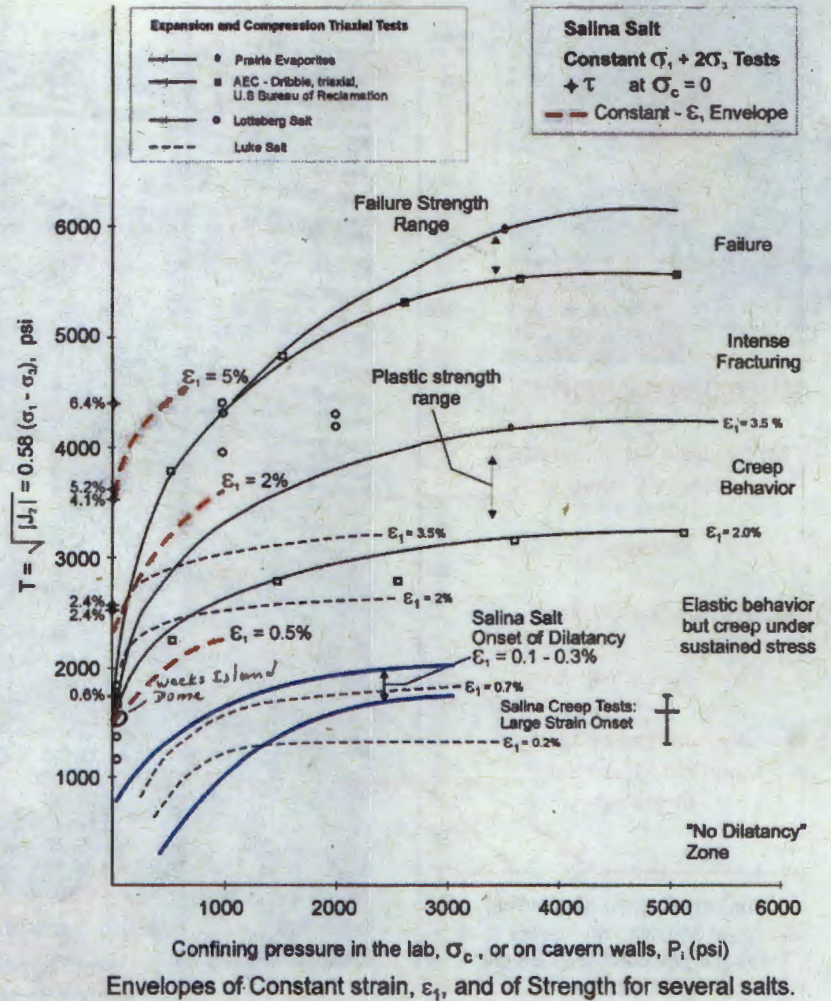


Figure 13: Strength Envelopes of Various Salts, Including Salt Domes.





**UNITED SALT CORP.**

**USC Saltville Brine, LLC**

4800 San Felipe  
Houston, Texas 77056  
Main Office: (713) 877-2600

July 29, 2013

Delivered Via Email with Read Receipt Requested  
[Bennett.James@EPAMail.EPA.gov](mailto:Bennett.James@EPAMail.EPA.gov)

Mr. James C. Bennett, Environmental Engineer  
United States Environmental Protection Agency  
Ground Water and Enforcement Branch  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

**RE: Limited Liability Company Name Change – UIC Permit Number VAS3G931BSMY**

Dear Mr. Bennett:

On July 1, 2013, the name of "Texas Brine Company Saltville, LLC" was amended to "USC Saltville Brine, LLC" (USCSB). The name change was effective in Virginia on July 8, 2013 by submission to the Commonwealth of Virginia State Corporation Commission (SCC). The original SCC Limited Liability Company Identification Number remains T034331, and similarly, the original date of filing remains May 18, 2007. Please find the current SCC information printouts attached (2 pages).

On July 1, 2013, the parent company, Texas Brine Company, LLC, sold its one hundred percent (100%) interest in the now USC Saltville Brine, LLC to USC Holdings Corporation. Please note that USC Holdings Corporation owns one hundred percent (100%) of the issued and outstanding stock for United Salt Corporation, which also has operations in Saltville. Additionally, on July 1, 2013, USC Saltville Brine, LLC assigned new officers as follows:

- Kyle Rash, President, USC Saltville Brine, LLC
- Cathy Gillies, Secretary, USC Saltville Brine, LLC
- Stacey Owens, Treasurer, USC Saltville Brine, LLC

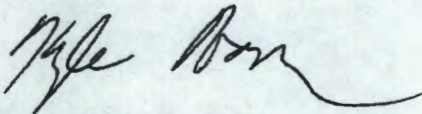


Mr. James Bennett - EPA  
July 29, 2013

In addition to the officers listed above, USCSB also hereby authorizes the following specific individuals to sign permit documents and submissions as representatives of this company:

- Scott Whitelaw, Vice-President, EHS&S, Texas United Corporation
- Ernest Sands, II, Saltville Plant Manager, United Salt Corporation
- Roscoe Call, Brine Field Manager, USC Saltville Brine, LLC
- Joseph Vance, PE, Consultant, Raegan Engineering, PC

Sincerely,



Kyle Rash, President  
USC Saltville Brine, LLC  
4800 San Felipe  
Houston, Texas 77056-3908  
Office: (713) 877-2601  
[KRash@UnitedSalt.com](mailto:KRash@UnitedSalt.com)

Cc Via Email:

Stephen Platt, [Platt.Steve@EPA.gov](mailto:Platt.Steve@EPA.gov)  
Wayne Sneed, [WSneed@TUM.com](mailto:WSneed@TUM.com)  
Fred Wolgel, [FWolgel@TUM.com](mailto:FWolgel@TUM.com)  
Mai Huynh, [MHuynh@TUM.com](mailto:MHuynh@TUM.com)  
Jim O'Donnell, [JODonnell@UnitedSalt.com](mailto:JODonnell@UnitedSalt.com)  
Scott Whitelaw, [SWhitelaw@TUM.com](mailto:SWhitelaw@TUM.com)  
Cathy Gillies, [CGillies@TUM.com](mailto:CGillies@TUM.com)  
Stacey Owens, [SOwens@TUM.com](mailto:SOwens@TUM.com)  
Mark Cartwright, [MCartwright@UnitedBrine.com](mailto:MCartwright@UnitedBrine.com)  
Dave Dickehut, [DDickehut@UnitedBrine.com](mailto:DDickehut@UnitedBrine.com)  
Ernest Sands, [ESands@UnitedSalt.com](mailto:ESands@UnitedSalt.com)  
Roscoe Call, [RCall@UnitedSalt.com](mailto:RCall@UnitedSalt.com)  
Eileen Rangel, [ERangel@TUM.com](mailto:ERangel@TUM.com)  
Becky Dorn, [BDorn@TexasBrine.com](mailto:BDorn@TexasBrine.com)  
Nicole Shanklin, [Nicole.Shanklin@Chamberlainlaw.com](mailto:Nicole.Shanklin@Chamberlainlaw.com)  
Joseph Vance, [JVance@RaeganEngineering.com](mailto:JVance@RaeganEngineering.com)





Commonwealth of Virginia  
State Corporation Commission

S  
Cor

Virg

07/14/13

LLCM3220

LLC DATA INQUIRY

16:21:00

LLC ID: T034331 - 1 STATUS: 00 ACTIVE

STATUS DATE: 12/17/08

LLC NAME: USC Saltville Brine, LLC

DATE OF FILING: 05/18/2007 PERIOD OF DURATION: 99/99/9999 INDUSTRY CODE: 00

STATE OF FILING: TX TEXAS

MERGER INDICATOR:

CONVERSION/DOMESTICATION INDICATOR:

P R I N C I P A L O F F I C E A D D R E S S

STREET: 4800 SAN FELIPE ST

CITY: HOUSTON

STATE: TX ZIP: 77056-0000

R E G I S T E R E D A G E N T I N F O R M A T I O N

R/A NAME: CT CORPORATION SYSTEM

STREET: 4701 COX RD STE 301

RTN MAIL:

CITY: GLEN ALLEN

STATE: VA ZIP: 23060-6802

R/A STATUS: 5 ENTITY AUTHORIZ EFF DATE: 05/18/07 LOC: 143 HENRICO COUNTY

YEAR

FEES

PENALTY

INTEREST

BALANCE

13

50.00

(Screen Id:/LLC\_Data\_Inquiry)





Commonwealth of Virginia  
State Corporation Commission

S  
Cor.

Virg

07/14/13

LLCM3260

OLD NAME INQUIRY

16:24:42

LLC ID: T034331 - 1

LLC STATUS: 00 ACTIVE

LLC NAME: USC Saltville Brine, LLC

OLD NAME:

DATE OF NAME CHANGE:

TEXAS BRINE COMPANY SALTVILLE, LLC

07/08/13

---

(Screen Id:/LLC\_Old\_Name\_Inquiry)





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
1650 Arch Street  
Philadelphia, Pennsylvania 19103-2029

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

Mr. Mark J. Cartwright, President  
Texas Brine Company Saltville, LLC  
4800 San Felipe  
Houston, Texas 77056-3908

RE: Underground Injection Control (UIC) Permit VAS3G931BSMY

Dear Mr. Cartwright:

The Environmental Protection Agency (EPA), recently learned of a sinkhole in Assumption Parish, Louisiana that may be linked to salt solution well owned and operated by Texas Brine. Texas Brine has an existing request to expand their current permit from seven wells to a total of seventeen wells. EPA is requesting Texas Brine to review their operations at both the Saltville, Virginia and Assumption Parish, Louisiana locations and determine why the operations at the Saltville, Virginia plant are managed in a way to prevent such an occurrence.

If you should have questions regarding this request, please give me a call at 215-814-5469.

Sincerely,

A handwritten signature in blue ink, which appears to read "James C. Bennett", is written over a horizontal line.

James C. Bennett  
Ground Water and Enforcement Branch (3WP22)  
Office of Drinking Water & Source Water Protection

